All’s Well that Ends Well:
Repurposing Depleted Oilfields for Enhanced Geothermal

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Geothermal energy

WATER

HEAT

PERMEABLE ROCK

https://www.petropedia.com/grasping-the-concept-of-rock-permeability/2/9896

Enhanced geothermal can unlock 500 GWe from Earth's crust

WATER **HEAT** **PERMEABLE ROCK**

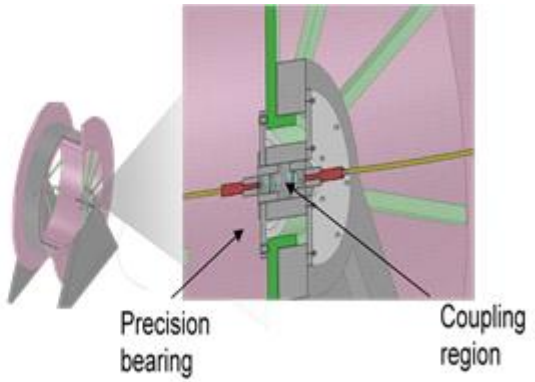
Need to drill 3-10 km deep underground
Need to make the rock permeable

https://www.petropedia.com/grasping-the-concept-of-rock-permeability/2/9896

Drilling is expensive

- Extensive knowledge from oil and gas industry
- Foro Energy: World's first hybrid laser-mechanical drill assembly technology

Drilling operations cost tens of millions of dollars



The economic benefit – a 25 MW plant

Exploration + Drilling Costs

= $ 27 million

Power Plant Construction Costs

= $ 67 million

CHANGING WHAT'S POSSIBLE

Using numbers for the FORGE project in the proposed Milford, UT site
Resource temperature: 200 ºC, Resource Depth: 2km

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What if we don’t have to drill?

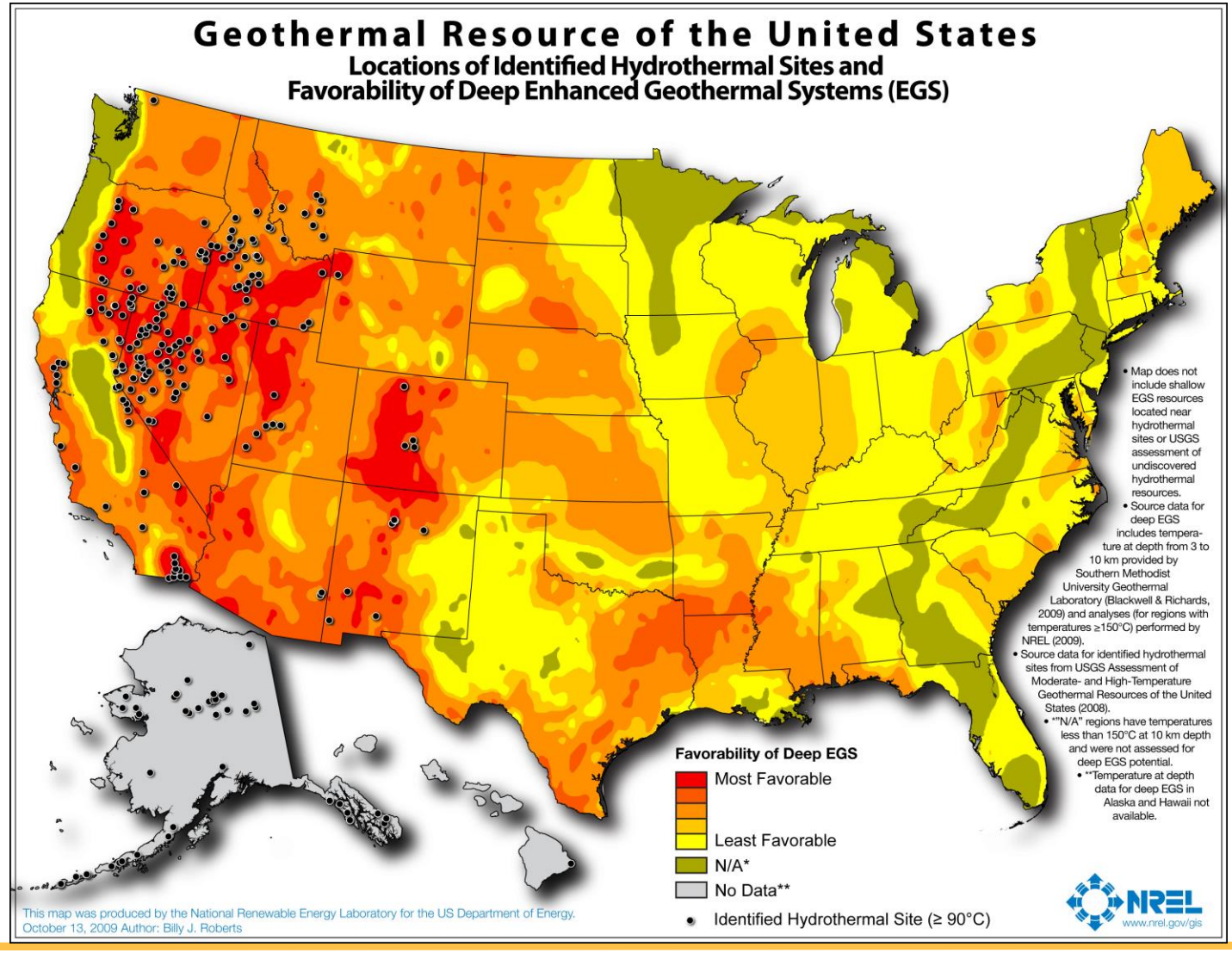

Image Source: https://www.americangeosciences.org/critical-issues/maps/geothermal-energy-resource-US
https://www.washingtonpost.com/graphics/national/united-states-of-oil/

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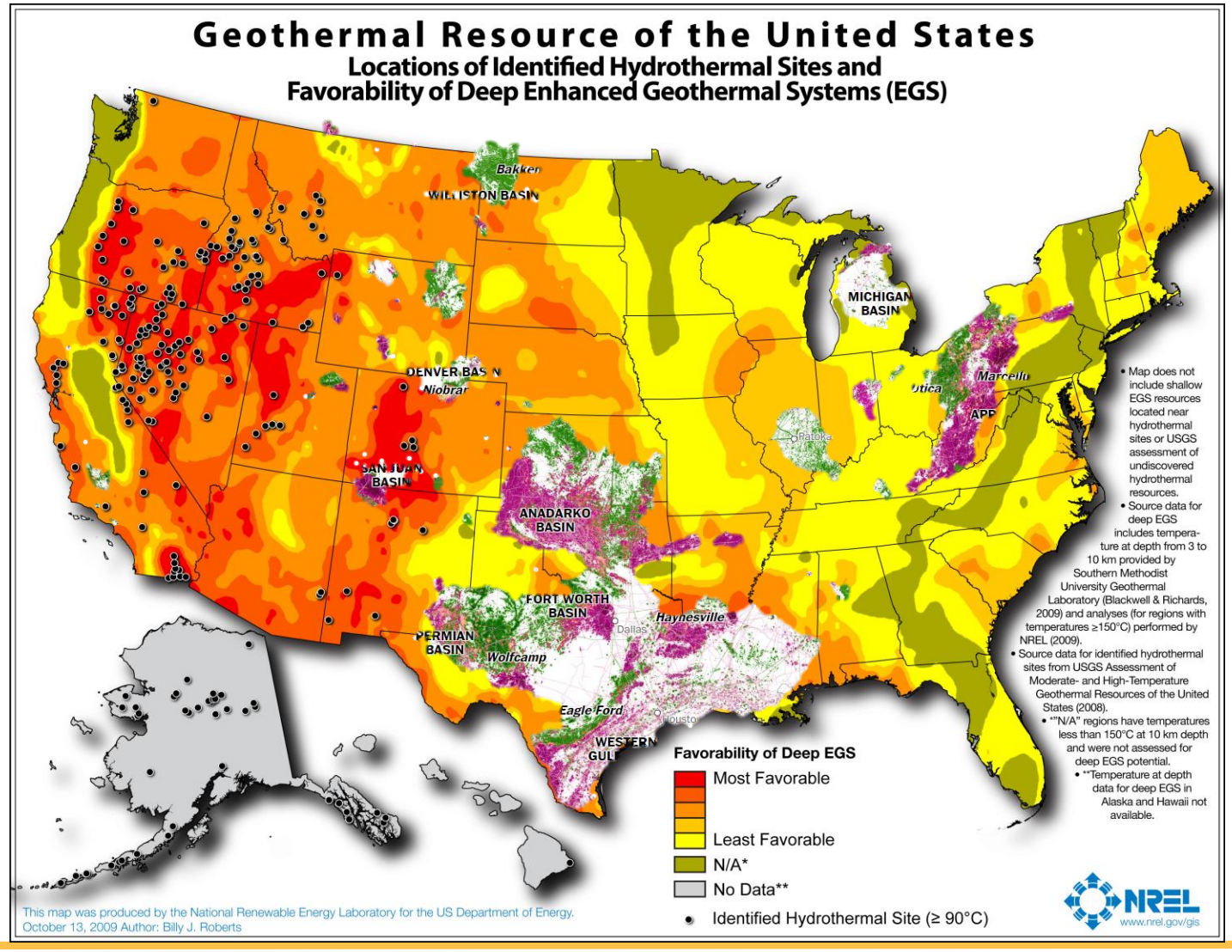

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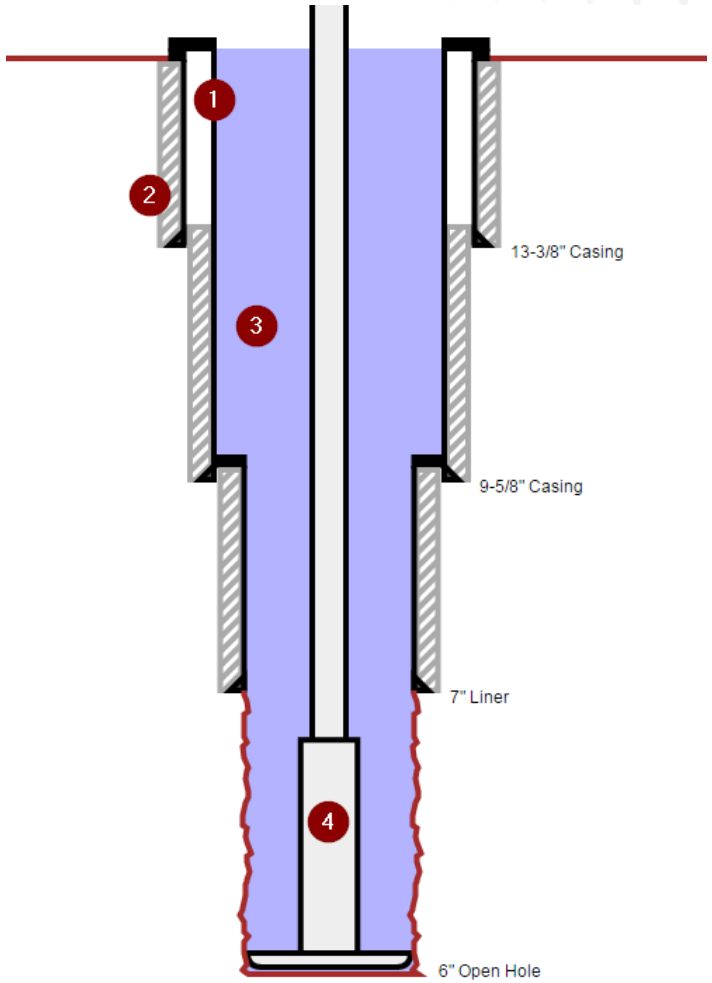
Re-using an abandoned oilwell

- Anadarko Basin
  - Many oilwells up to 5000m deep
  - 70,000 sq miles
  - More than 4000 wells
- Cement casing – can it be reused?
- May need to drill deeper to get to the hot rock – but exploration costs are minimized
- Wells can be directionally drilled – how do we take advantage of that?



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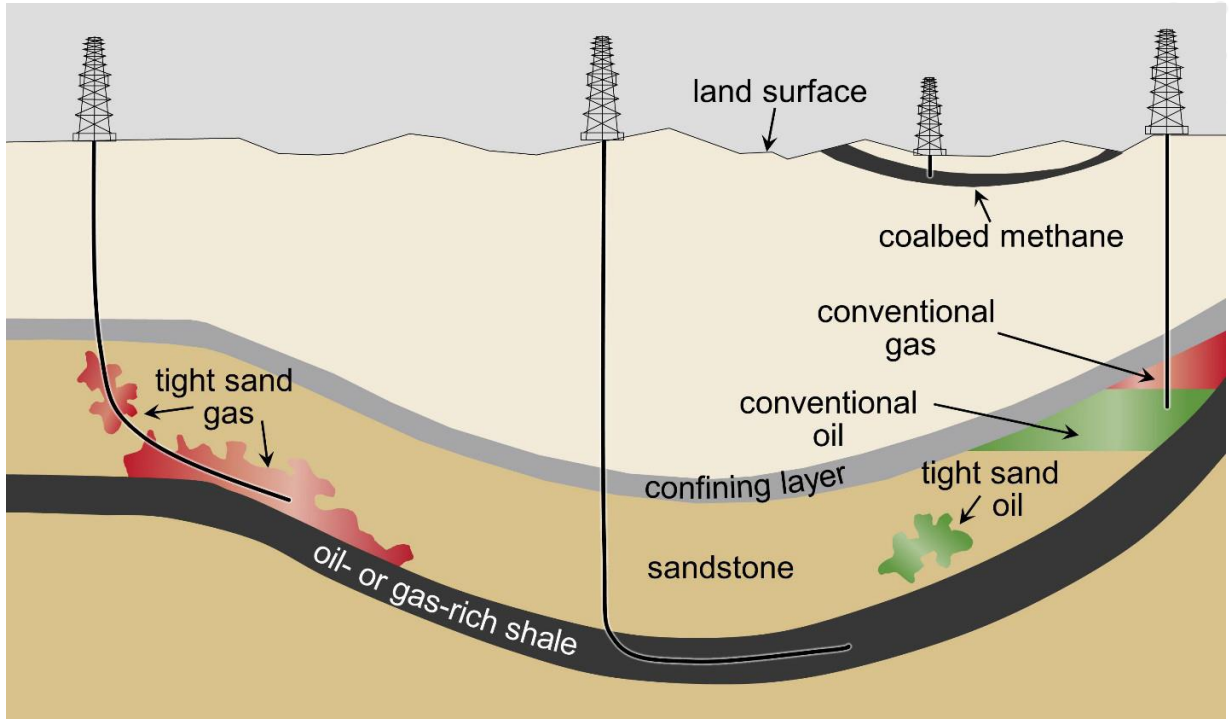
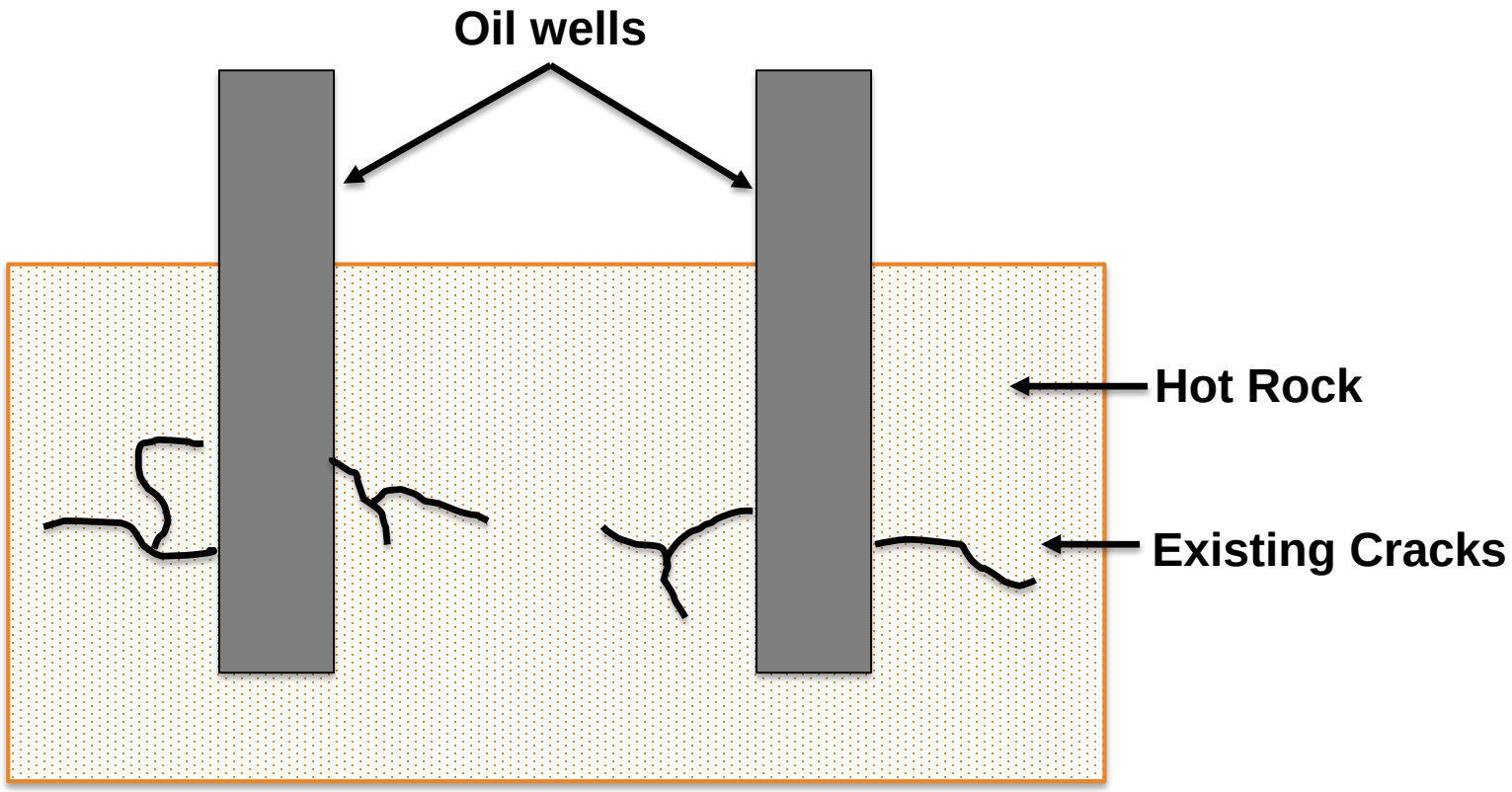
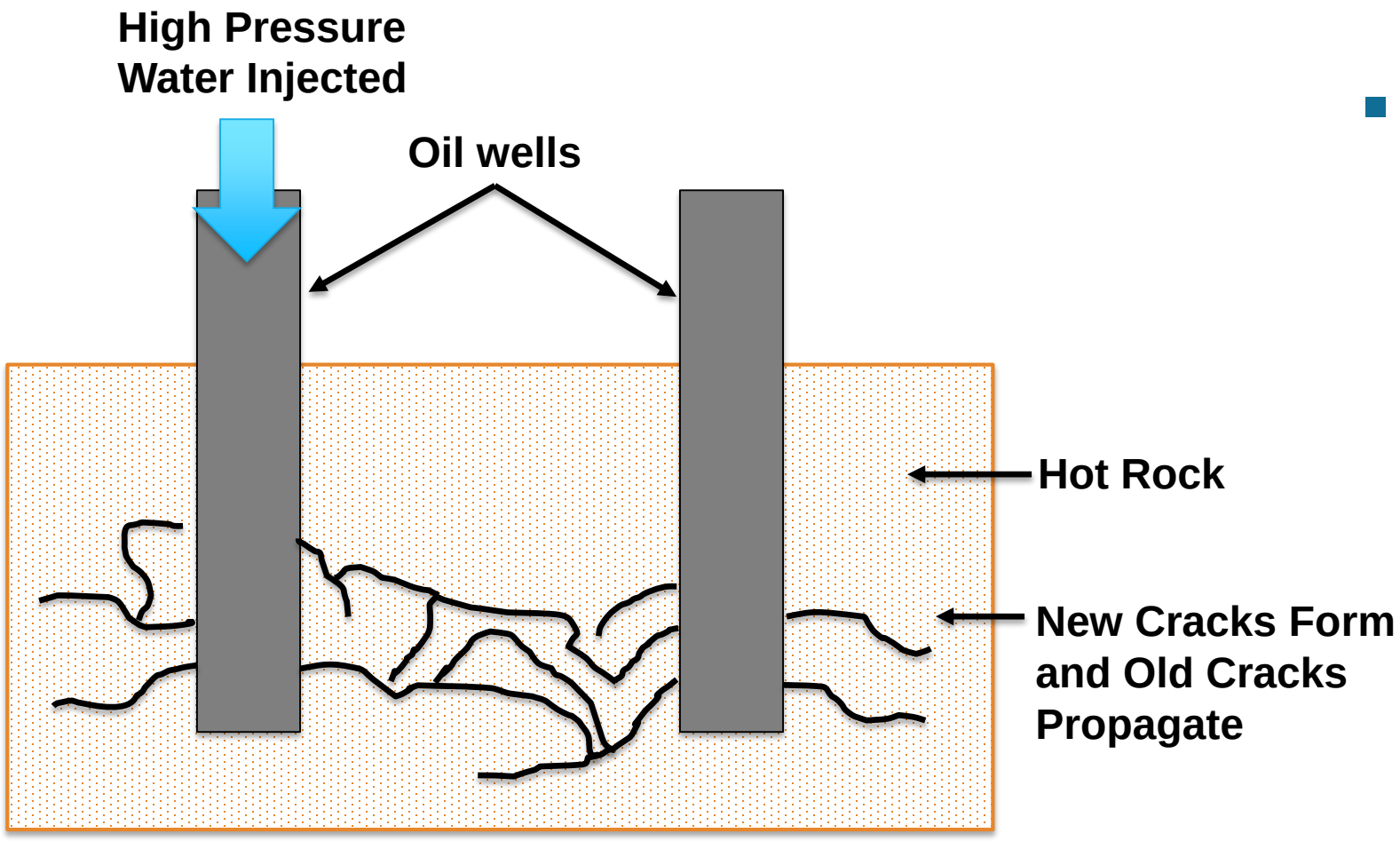


Rock fracture map needed



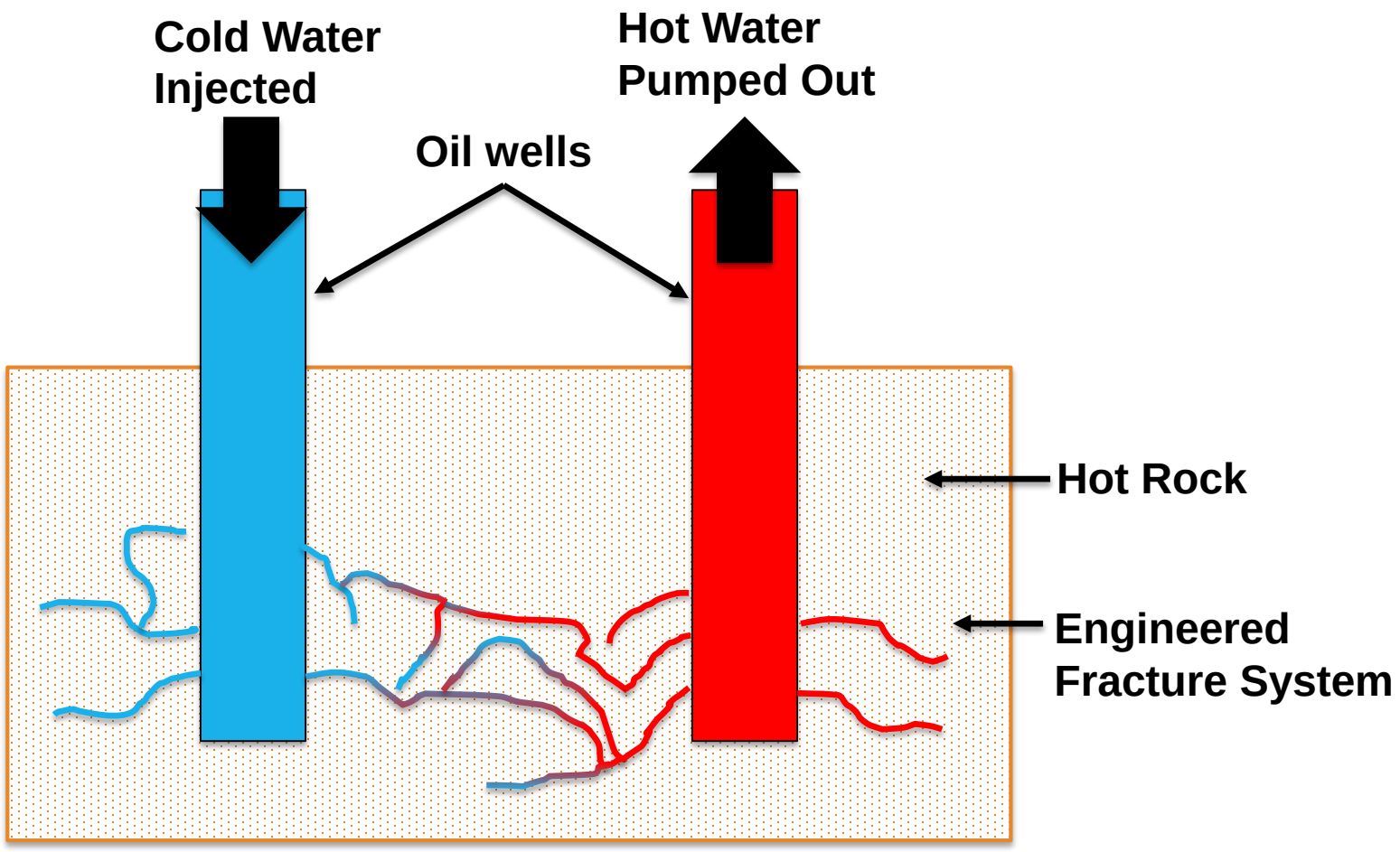
- Need to:
  - Accurately measure where existing cracks are
  - Predetermine the optimal fracture map

Rock fracture map needed



- Hydro-stimulation → induce new fractures in the rock
- Ensure complete pathways for water

Rock fracture map needed

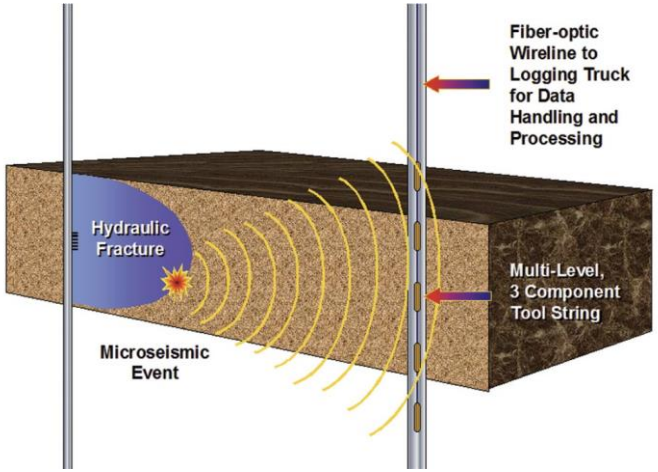


- Monitor fracture patterns during operation - some approaches:
  - Microseismic methods
  - Electromagnetic monitoring

Advances in subsurface characterization are critical

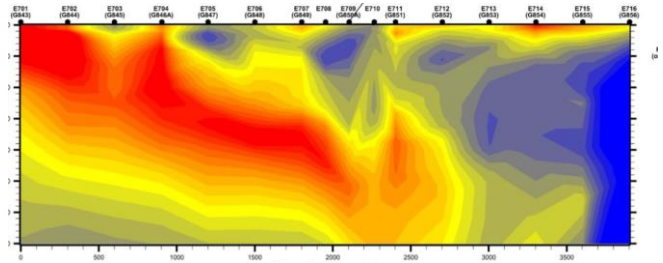
Microseismic methods

- Industry standard
- Measure microseismic events due to “rock noise” to pinpoint its location



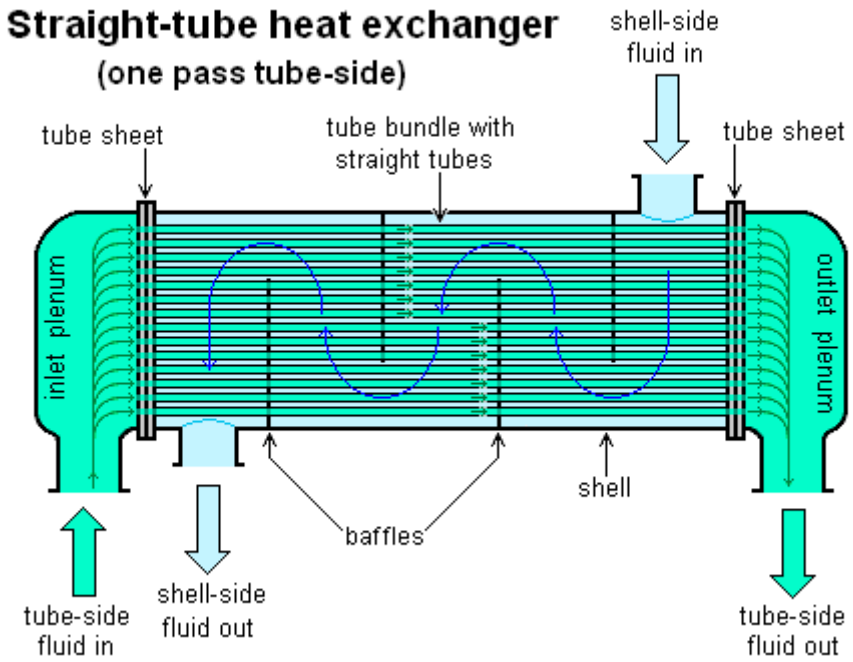
Magnetotelluric methods

- Research stage
- Measure fluid flow patterns to image the fracture network



https://commons.wikimedia.org/w/index.php?curid=7849149
Image courtesy of John Logel: https://csegrecorder.com/articles/view/integration-of-rate-transient-and-microseismic-analysis

Challenge – Engineer an underground heat exchanger!



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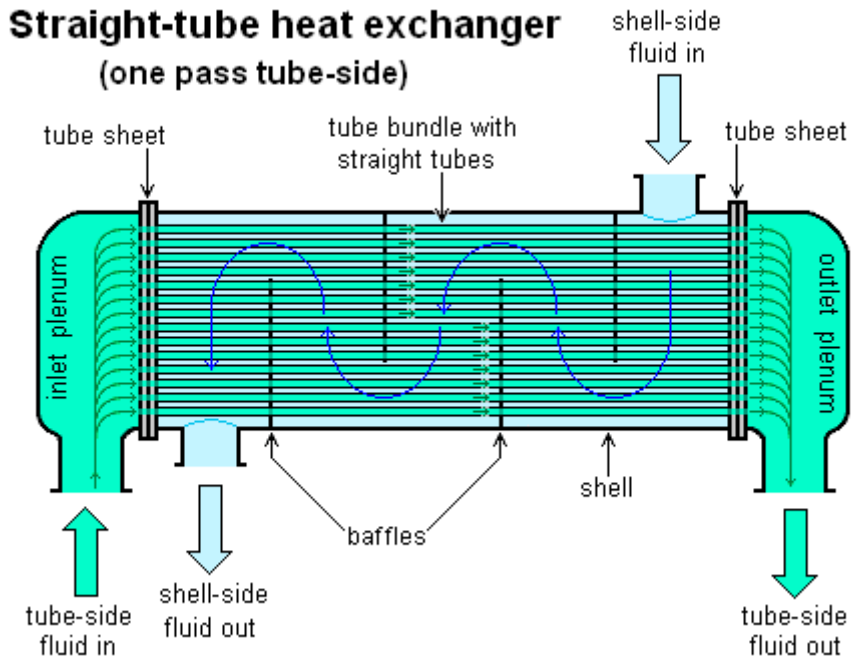

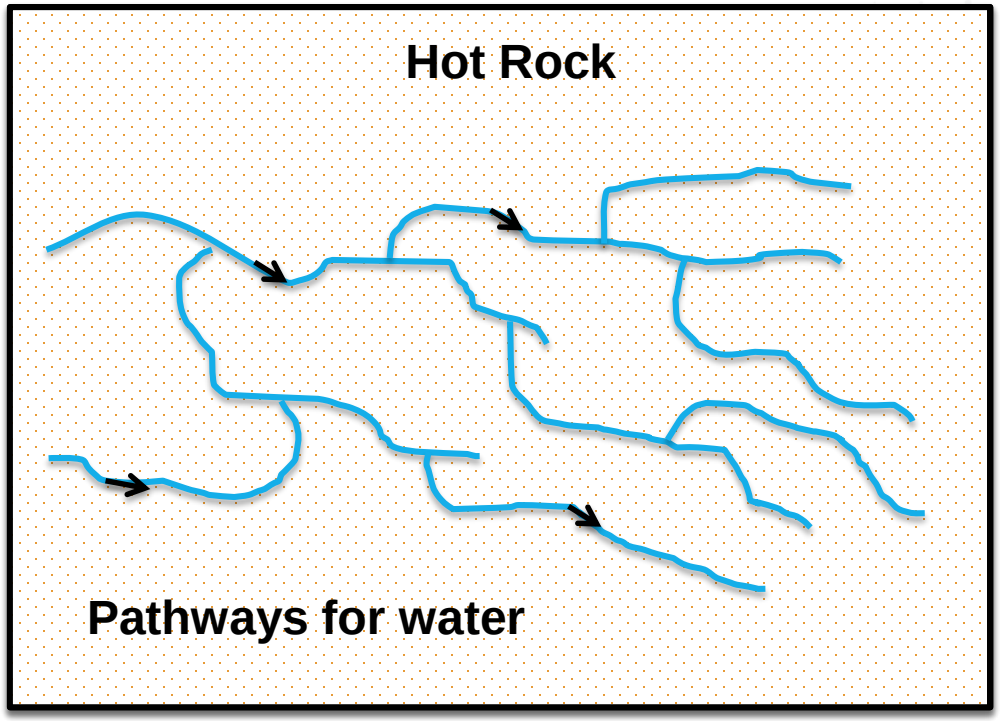

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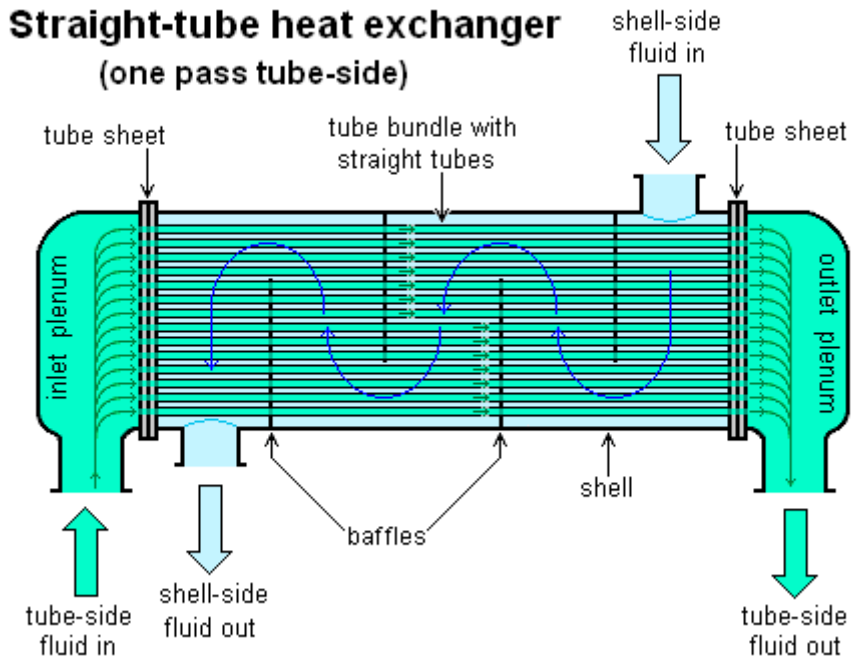

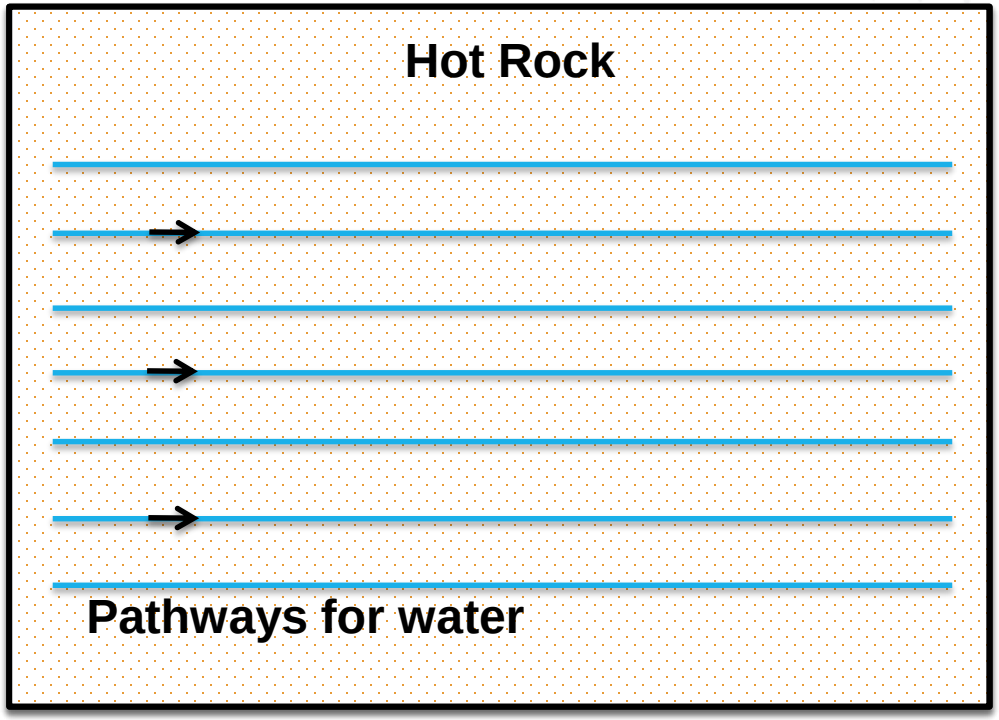

Shell Perdido Oil Platform

Moored at ~2400m
Drilled at ~2900m below ocean surface

Off-shore enhanced geothermal

- Water temperature at 1000m: ~4°C
- Increase in available power: 16%

- Basalt in oceanic crust: Easy to fracture
- Oceanic crust is thinner, higher temperatures

Conclusion

We can reuse existing oil and gas wells for reliable, renewable enhanced geothermal energy

Thank you!

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Shell Perdido Oil Platform: https://www.flickr.com/photos/royaldutchshell/4276533788
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